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**PATENT REQUEST: STANDARD PATENT/PATENT OF ADDITION**

We, being the person(s) identified below as the Applicant, request the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

Full application details follow.

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[54] Invention Title: PAPER USED AS LINING PAPER FOR PLASTERBOARDS AND  
PROCESSES FOR ITS MANUFACTURE

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**BASIC CONVENTION APPLICATION(S) DETAILS**

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PAPER USED AS LINING PAPER FOR PLASTERBOARDS AND PROCESSES FOR ITS  
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The subject of the invention is a paper used as lining paper for plasterboards, characterised in that it consists of a sheet of lining paper for plasterboard, covered with a pigment layer, in that the ply of the paper sheet, to which the said pigment layer is applied, is based on at least one light-coloured, and preferably white, inorganic filler and new or recovered, predominantly chemical, bleached cellulose fibres, in that the said pigment layer is based on at least one light-coloured, and preferably white, inorganic filler of a chemical nature which is identical with or different from that of the inorganic filler of which the said ply consists, of at least one binder and, if need be, of various adjuvants which make it possible to prepare a pigment slip of suitable rheology, and in that the weight of the deposited pigment layer is at least 6 g/m<sup>2</sup>.

## Claim:

1. Paper used as lining paper for plasterboards, characterised in that it consists of a sheet of lining paper for plasterboard, covered with a pigment layer, in that the top ply of the paper sheet, to which the said pigment layer is applied, is based on at least one light-coloured, and preferably white, inorganic filler and new or recovered, predominantly chemical, bleached cellulose fibres, in that the said pigment layer is based on at least one light-coloured, and preferably white, inorganic filler of a chemical nature which is identical with or different from that of the inorganic filler of which the said ply consists, of at least one binder and, if need be, of various adjuvants which make it possible to prepare a pigment slip of suitable rheology, and in that the weight of the deposited pigment layer is at least  $6 \text{ g/m}^2$ .

13. Pigment slip employed for preparing the lining paper for plasterboards as defined in one of the preceding claims, characterised in that the inorganic filler forming part of the composition of the pigment slip is calcium sulphate dihydrate or calcium carbonate.

28. Coating process characterised in that the application of the pigment slip defined in the preceding Claims 13 to 27 for preparing the lining paper for the plasterboards defined in the preceding Claims 1 to 12, is performed with the aid of mechanical deposition means chosen from those promoting a deposit of pigment layer predominantly on the surface of the cream ply, such as the systems using a scraping or smoothing blade or systems using equalising bars, when the slip has a high solids content, generally higher than 60 % by weight.

AUSTRALIA

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**ORIGINAL  
COMPLETE SPECIFICATION  
STANDARD PATENT**

Application Number:

Lodged:

Invention Title:

PAPER USED AS LINING PAPER FOR PLASTERBOARDS AND  
PROCESSES FOR ITS MANUFACTURE

The following statement is a full description of this invention, including the  
best method of performing it known to :- us

The present invention relates to a paper used as lining paper for plasterboards, the process for its preparation and a plasterboard lined with this paper.

Plasterboards conventionally consist of a plaster body cast in a factory between two paper sheets forming its facing and its reinforcement at the same time.

The manufacture of these plasterboards is carried out by linking the following operations into a sequence:

- two reels of paper are unwound continuously, one under the mixer containing the plaster paste (facing paper), the other above,
- the slaked plaster is cast onto the lower paper sheet whose edges have been folded back,
- the upper paper sheet closes the mould thus formed, its edges are bonded onto the folded-back edges of the lower sheet,
- the whole is "rolled" by a roll or a forming plate and conveyed on a belt and then rollers as far as the "knife" or "guillotine",
- setting having taken place meanwhile, the boards are cut to length, turned over in order that the facing paper should not be subjected to following transfers, and are distributed onto the stages for entry into the drier,
- the boards, which are moist at this stage, are dried for approximately  $3/4$  of an hour, and are then taken out of the oven,
- they are cut again to the desired accurate length and are assembled in pairs (for subsequent handling on work site) and are then stacked,
- they are then ready for use at the work site.

The two sensitive points of this manufacture which require very particular attention are the plaster setting time and the drying:

- the former because, in the case of a given line, it often limits its speed and hence production capacity,
- the latter because it fundamentally determines the quality of the finished product.

5

The setting of the plaster must be controlled in order that it should begin only on leaving the mixer and that the plaster should have hardened sufficiently to be capable of being sectioned approximately 5 minutes later. On the control of this phenomenon will depend the ratio of the operating speed (and hence the production efficiency) and the length of the manufacturing line (and hence the capital cost). When the plaster is setting, another parameter which is  
15 equally important for attaining performance, both in respect of production efficiency and capital cost, consists of the paper employed. In fact, the plaster paste is highly laden with water, up to 50 % by weight of water, when it is cast between the paper sheets.  
20 Each m<sup>2</sup> of paper can then absorb of the order of 200 g of water. In order to withstand, without being damaged, both the presence of water and the speed of travel of the belt conveying the boards being formed, the paper must have high capacities for water absorption and good  
25 physical and dimensional strength in a wet medium.

Furthermore, the characteristics of the paper constitute a parameter of primordial importance for the drying operation. This operation consists in extracting the water present in excess in relation to the quantity  
30 needed merely to reconstitute gypsum from the plaster while a stream of hot air is circulated around the boards. In order that the drying operation may be as fast as possible, the paper must be sufficiently porous to promote the migration of water, because this makes  
35 it possible to lower the temperature of the drying gases and to obtain faster drying and, consequently, the cost of this operation can be reduced appreciably.

In addition, the paper must have a good dimensional stability with temperature, because the drying

temperature is relatively high: drying of plasterboard is generally carried out at a temperature of between 100°C and 200°C for a period in excess of 20 minutes and generally of the order of 30 minutes.

5 Otherwise, if the porosity of the paper is insufficient or if its dimensional stability with temperature is too low, there is an increasing risk of debonding between the paper and the plaster core, which is reflected especially in the formation of blisters,  
10 which make the product unmarketable.

Papers for plasterboards which, after conditioning at 23°C and 50 % relative humidity according to NF Standard Q 03-010, conform to the following characteristics are usually chosen:

15

TEST	USUAL VALUES
Weight per unit area (NF Q 03-019)	200 to 275 g/m <sup>2</sup>
Thickness (NF Q 03-016)	0,2 to 0,5 mm
Water absorption on the inner face, i.e. the face in contact with the plaster core, or Cobb 3 minutes (NF Q 03-014)	20 to 70 g/m <sup>2</sup>
Water absorption on the outer face or Cobb 3 minutes (NF Q 03-014)	20 to 100 g/m <sup>2</sup>
Permeability to air (GURLEY porosity) (NF ISO 5636/5)	usually between 25 s and 100 s and in some cases capable of being up to 135 s
Rupture strengths measured on test pieces of width equal to 15 mm (length direction: LD, transverse direction: TD) (NF Q 03-004)	TD from 4 to 9 daN LD from 15 to 25 daN
Interply strengths	from 30 to 110 J/m <sup>2</sup>
Elongation under water measured at 1 minute at 23°C in the transverse direction (NF Q 03-063)	lower than 4 %

Usually one of the two paper sheets employed for manufacturing plasterboards is dark in colour and

can vary between a grey colour and a brown colour because it consists of cellulose fibres which have not been subjected to any particular purification treatment. This so-called grey paper is conventionally  
5 obtained from unbleached chemical pulp and/or mechanical pulp and/or thermomechanical pulp and/or semichemical pulp. A mechanical pulp usually means a pulp obtained entirely by mechanical means from various raw materials, essentially wood, which can be  
10 contributed by recovered products originating from wood, such as old cartons, kraft paper trimmings and/or waste newspapers. A thermomechanical pulp means a pulp obtained by heat treatment followed by a mechanical treatment of the raw material. A semichemical pulp  
15 means a pulp obtained by removing from the raw material a part of its noncellulosic components by means of a chemical treatment; a subsequent mechanical treatment is needed to disperse the fibres. For practical reasons, in the remainder of the description the  
20 expression "mechanical pulp" will refer equally to unbleached chemical pulps, thermomechanical pulps, semichemical pulps, mechanical pulps as defined above and to a mixture of two or more of these pulps.

The other sheet has a face referred to as being  
25 "cream"-coloured; this is the facing paper. This cream-coloured face constitutes the visible face of the standard plasterboards once they have been installed. To obtain this colour, the layer(s) of this face are based on optionally bleached chemical pulp made up of  
30 recycled and/or fresh cellulose fibres and/or optionally bleached "mechanical pulp". A chemical pulp means a pulp obtained by removing from the raw material a very high proportion of its noncellulosic components by a chemical treatment, for example by cooking in the  
35 presence of suitable chemical agents such as sodium hydroxide or bisulphites. When this chemical treatment is supplemented by a bleaching treatment, this removes a large part of the coloured substances which accompany the cellulose fibres, as well as the substances liable



to degrade on aging and to give unpleasant yellow shades linked with the presence of substances such as lignin.

5 In the remainder of this text the sheet comprising a "cream"-coloured face will be referred to as "cream paper".

For reasons of economy, the aesthetic qualities of the cream paper are increasingly poor; in particular, the thickness of the cream paper layer is increasingly thin and the purity of the cellulose fibres chosen is increasingly poor. As a result, the colour of the cream paper is very variable in quality and can range from a grey or yellow shade to a white shade. Now, the plasterboard market calls for surfaces of improved aesthetic qualities in order not to have to perform the finishing immediately.

With the aim of producing a paper exhibiting improved strength and porosity qualities and which is additionally economical, International Patent Application WO 88/0,371 proposes a paper based on fibres originating from recycled paper, of nonwhite quality, onto which is deposited a coating slip consisting of a filler or of a pigment, white and of inorganic origin, of a binder, of kaolin and optionally of other adjuvants. This paper is devoid of cellulose fibres originating from a bleached chemical pulp; according to this application the "cream" colour is contributed by the coating slip.

Papers which have the composition described in this application have been manufactured and used as lining papers for plasterboards. In fact, these papers exhibit a porosity which is excellent but which results in the absorption of a large part of the coating compositions. The absorption of the pigment composition is additionally increased by the recommended coating method which is, in this case, a water chest mounted on a calender which, on the one hand, imposes slips of low solids content and, on the other hand, promotes the penetration of the slip into the paper. It should be

noted that in most cases the envisaged deposition system gives rise to a heterogeneous slip distribution.

The distribution of the resulting cream shade is very nonuniform; it is in fact speckled, that is to say consisting of light spots which stand out clearly in relation to the remainder of the paper which is, in this case, relatively grey and/or brown in colour. Apart from a porosity which is highly variable from one point to another, these papers exhibit a mediocre state of surface quality, in the form of nonuniformities of relief. The changes in porosity associated with the changes in surface quality probably give rise to changes in penetration and bonding of the coating slip, this being all the more so since the solids content of the coating slip is low, which may account for the absence of uniformity in the colour of these papers. The contrast is proportionately more marked the greater the difference in colour which exists between the paper and the pigment layer.

Furthermore, the coating method mentioned in International Application WO 88/0,371 does not make it possible to guarantee a homogeneous deposition on the paper; the slip film created on the calender by this coating system is not homogeneous and consequently its transfer onto the paper cannot be homogeneous either.

The use of a white filler renowned for its high hiding power, titanium oxide in this case, in accordance with the operating conditions prescribed by this application, has not made it possible to get rid of the formation of white and contrasting spots on a grey background. A high proportion of this white pigment, which is known for its opacifying properties, must be employed to obtain the required aesthetic qualities and, in this case, the cost of the papers obtained is prohibitive for a plasterboard application. In addition, increasing the thickness of the lining layer in this way greatly reduces the porosity of the paper and, consequently, the risks of paper separation, especially in the form of blisters, are increased.

In conclusion, the aesthetic qualities of the papers described in International Application WO 88/0,371 are not satisfactory and their improvement by virtue of an additional introduction of pigment is not acceptable in the plasterboard field for economic reasons.

Another major difficulty which also bears on the aesthetic qualities of plasterboards arises if the plasterboards are not employed quickly, which is frequently the case. In fact, the plasterboard lining paper, and in particular the cream-coloured lining paper, acquires an unpleasant yellow shade under the effect of light.

This yellowing arises chiefly from the impurities present with the cellulose fibres in the paper. In fact, depending on their degree of purity, cellulose fibres contain more or less considerable quantities of substances of natural origin which have the property of yellowing under the effect of light. Moreover, they can also contain dark-coloured substances when they originate from recycled paper. Treatments for eliminating these substances completely are complex and costly and can be envisaged on an industrial scale only for highly specific paper applications.

Now, a fairly long period elapses between the time when the plasterboards leave the manufacturing lines and that when, once the board has been positioned, the cream paper receives the final decorative coating; among the main operations to which the plasterboards are subjected on leaving the production shop there may be mentioned storage on the manufacturing site and then on the construction site, followed by installation of the board. An even longer time may elapse, which may be up to 6 months, before the final decoration applied (wallpapering, painting and the like). When these various operations take place the "cream" paper is exposed to light on many occasions and tends gradually to take on unpleasant yellow shades

of fairly high value since, as already stated, its top layer does not consist 100 % of only new cellulose fibres originating from bleached chemical pulp, this being essentially for economic reasons.

5           Now, the visibility of these yellow shades is further emphasised by the white colour of the joints present between the boards.

10           A loss in the degree of whiteness and an increase in the yellowing value are also found when paper coated with a layer of polymers is exposed to light. This phenomenon has been observed in particular on silicone-lined papers, starched papers and papers coated with a surface layer of sizing. To mask the yellowish shades and to make the joints invisible in  
15 relation to the boards and to decorate these boards it is customary to supplement the decorative layer applied to the board with an additional and sufficient quantity of finishing product, this being proportionately more so the lighter the colour of the decorative layer. Such  
20 a solution is therefore not economical, insofar as it involves the use of a large quantity of generally costly decorative product.

          Another drawback lies in the fact that, if a wallpaper is bonded directly onto the cream paper  
25 without producing an intermediate finish layer, it is subsequently very difficult to remove this wallpaper without at the same time partially or completely tearing the cream paper away from the plasterboard. A first consequence is the lowering in the mechanical  
30 properties of the board. A second consequence arises from the aesthetic appearance of the boards which include intact (cream) parts and torn-away parts, grey and/or brown in colour. To mask these shade differences it becomes necessary to apply a substantial decorative  
35 layer. This solution is, of course, not satisfactory because of its cost.

          Another defect of the cream paper lies in the fact that it can be very easily soiled during the various handling operations to which plasterboards are

subjected, and most of this soiling is virtually impossible to remove. In the same way as in the case of the unpleasant yellow shades, an additional quantity of finishing layer is usually resorted to in order to mask this soiling.

The subject of the present invention is a paper used as lining paper for plasterboards, which does not exhibit the drawbacks of the known papers, but which meets the various requirements sought after in this technical field.

A main objective is a paper which, while being at the same time simple and economical, substantially retains its original colour when exposed to light.

Another objective is a paper which is sufficiently porous to be used as lining paper in the manufacture of plasterboards and to allow them to be dried without appreciable increase in the drying temperature and time and without risk of separation of the paper from the plaster core.

Another objective is a paper which has the property of being easily cleaned when soiled by substances of inorganic origin, as can often happen on a construction site.

Another objective is a paper which does not require any intermediate finish layer and which, when combined with wallpaper by bonding, allows this wallpaper to be removed without undergoing damage.

Another objective is a paper which is widely satisfactory when paint is applied to it.

More precisely, the subject of the present invention is a paper used as lining paper for plasterboards, characterised in that it consists of a sheet of lining paper for plasterboard, covered with a pigment layer, in that the top ply of the paper sheet, to which the said pigment layer is applied, is based on at least one light-coloured, and preferably white, inorganic filler and new or recovered predominantly chemical, bleached cellulose fibres, in that the said pigment layer is based on at least one light-coloured, and

preferably white, inorganic filler of a chemical nature which is identical with or different from that of the inorganic filler of which the said ply consists, of at least one binder and, if need be, of various adjuvants which make it possible to prepare a pigment slip of suitable rheology, and in that the weight of the deposited pigment layer is at least 6 g/m<sup>2</sup>. The weight of the pigment layer is obtained using the difference in the weights per unit area of coated and uncoated paper according to the method indicated in the continuation of this text. In accordance with a characteristic of the invention the paper to be coated has a top layer (top ply) with a composition chosen to guarantee the opacity and the aesthetic qualities with regard to both its colour (light and uniform) and its surface appearance, which must be homogeneous and uniform:

- in fibre distribution,
- in surface roughness,
- in porosity or absorption capacity at the surface.

As will be explained in the continuation of this text, it has been found, in fact, that the combination of this paper and of the pigment layer defined in the invention provides the coated paper obtained with durable aesthetic qualities, this being without affecting the process of manufacture of plasterboards incorporating such a coated paper or impairing the mechanical characteristics of the paper and of the boards.

In the continuation of this description the expression "coated paper" will refer to the paper in accordance with the invention as defined above, in contrast to the paper traditionally employed for plasterboards, which does not comprise such a coating.

The term "ply" refers to a fibrous layer of uniform composition of the paper sheet, which is formed on the papermaking machine, for example either on the cloth or on the mould of a papermaking machine.

The coated paper according to the invention is made up of a paper sheet whose top fibrous layer, that is to say the part of the paper sheet facing outwards (in contrast to the bottom layer corresponding to the part of the sheet intended to be placed in contact with the core of the plasterboard), is coated with a pigment layer, the latter being in its turn intended to be coated with a decorative layer, for example of wallpaper or of paint. The fibrous top layer of the paper sheet may consist of one or more plies of the same manufacturing composition, combined by pressure in the wet state.

In accordance with a preferred embodiment of the invention a coating is produced predominantly on the paper surface in the case of which a good stability to light is required. The coated paper obtained exhibits the required durable aesthetic qualities, namely a light colour, which is preferably chosen to be white, which is, furthermore, uniformly distributed.

Although the air permeability value (Gurley porosity) of the coated papers according to the invention, obtained under the ISO 5636/5 standardised conditions, is clearly higher than that which is generally accepted in the plasterboard field, it has surprisingly been additionally observed that such a coating does not result in any loss in the permeability during the drying of the plasterboard and does not affect the manufacture of the plasterboards and, above all, does not make it necessary to slow down the rate of production.

The air permeability or Gurley porosity is measured according to the ISO 5636/5 standardised method; the flow time of a specified volume of air at a constant pressure through a defined area of paper is measured using this method.

In fact, it should be noted that papers for plasterboards with a porosity lower than a value of 100 s (Gurley) and more exceptionally lower than 135 s used to be chosen conventionally, this being in order

to promote a speed of operation during the drying which is economically acceptable. Now, the air (Gurley) permeability of the coated paper in accordance with the invention, before undergoing a drying operation under temperature conditions similar to those to which the plasterboard is subjected during its manufacture, is generally higher than 100 s (Gurley) and is more generally of the order of 150 s (Gurley). Under these conditions it was feared that there would be a slowing down of the plasterboard manufacture due to the use of this coated paper. On the contrary, it has been found that the use of the coated paper according to the invention does not affect the plasterboard manufacturing process.

A deposit of pigment layer with a weight per unit area of between 8 and 30 g/m<sup>2</sup> is preferably produced. Also preferably, the coated papers according to the invention comprise only 10 to 15 g/m<sup>2</sup> of pigment layer; under these conditions it has been possible to achieve all the abovementioned objectives.

The coated paper according to the invention is advantageous for more than one reason:

- it makes it possible to have a uniform plasterboard facing shade of high whiteness, and with the desired colour shades, with the result that the occupant of the room in which the partitions are made using such boards does not immediately have to paint;
- it greatly slows down and limits the yellowing of the plasterboard when it is exposed to sunlight or to light, by virtue of its resistance to light which is completely satisfactory under normal conditions of use;
- it is easily cleaned; under moderate conditions such as water to which soap has been added it is easy to remove successfully the inorganic impurities which may have adhered to it;
- it makes it possible to reduce to an appreciable extent the quantity of paint needed



for painting such boards, resulting in an appreciable saving for the customer;

- the use of a finishing agent before the bonding of wallpaper is no longer necessary with the coated paper according to the invention.
- Without having to prepare the surface, the coated paper according to the invention permits the correct removal of the wallpaper to which it is bonded, resulting in an appreciable saving for the customer. In fact, the coated paper according to the invention has a good tearing resistance. As a result of this it makes it possible, under normal removal conditions to separate the wallpaper from the coated paper without tearing off the pigment layer or the top ply.

In accordance with a principal characteristic of the invention, the surface quality of the paper to which a pigment layer is applied is provided with superior aesthetic qualities. The surface of the top ply of this paper is preferably higher than 50 in whiteness and preferably still higher than 60, under the conditions of measurement in accordance with NF Standard Q 03-039.

The surface roughness of the top ply of paper to which a pigment layer is applied is advantageously lower than 1500 Bendtsen and preferably even lower than 1000 Bendtsen, under the conditions of measurement in accordance with NF Standard Q 03-049.

The bleached, predominantly chemical, cellulose fibres and the fillers which predominantly constitute the top ply of the paper give it a shade which varies between cream and white shades. In what follows, this will be referred to as "cream ply". This terminology will be retained in the case where a colouring agent is incorporated in the cream ply. The cream ply is designed to form a covering which is opaque, of a light shade and uniformly distributed, and whose surface quality is smooth. To do this, the cream ply is

prepared from bleached, new or recovered cellulose fibres originating predominantly from bleached chemical pulp and from at least one white inorganic filler such as talc; the inorganic filler may be new or recovered.

5 Depending on the case, the white inorganic filler needed for the preparation of the cream ply will need to be added (in the case where the fibres are 100 % chemical and new) or white inorganic filler contributed by recycled fibrous matter will suffice if it makes it  
10 possible to obtain a sufficient opacity. The overall inorganic filler content of the cream ply is preferably limited to a maximum value of 35 % because above this value, depending on the papermaking machine employed and the fibre content of the ply, the risks of loss of  
15 cohesion and hence of obtaining insufficient mechanical properties are increased.

The cream ply preferably consists of at least 65 % by weight of bleached chemical cellulose fibres.

It has been noted that the behaviour of the  
20 coated papers according to the invention towards light and sunlight is good (absence of fast yellowing under normal use conditions) if the "mechanical pulp" content (including, as stipulated above, unbleached chemical pulps, thermomechanical pulps and/or semichemical  
25 pulps) of the cream ply is limited. The "mechanical pulp" content of the cream ply preferably does not exceed 30 % by weight, with reference to the dry weight of the cream ply.

In accordance with the invention the various  
30 new or recovered fibrous raw materials employed for preparing the cream ply are such that the cellulose fibres of which they consist are bleached and predominantly chemical. The chosen fibrous raw materials preferably also conform to at least one of  
35 the preferred variants indicated above.

White-quality, unprinted waste paper is advantageously used for introducing recovered, chemical, bleached cellulose fibres, optionally together with

bleached and mechanical cellulose fibres, into the fibre preparation used to manufacture the cream ply.

Also, the waste paper of white quality is preferably chosen from so-called top-quality, group C waste paper, in accordance with the European waste-paper nomenclature (CEPAC-1990). Among these, those more particularly chosen are:

C7- Wood-free white registry.

White, sorted, wood-free writing and printing papers originating from office registries, free from cash records, carbon paper and water-insoluble adhesively bonded backs, containing not more than 3 % of coloured self-copying papers.

Total of unusable matter: 1 % max.

C8- Wood-free, white continuous printed forms.

White, wood-free, multipart forms and continuous printed forms containing not more than 3 % of coloured self-copying papers.

C9- Colorant-free, wood-free, white continuous printed forms.

White, wood-free, multipart forms and continuous printed forms free from coloured self-adhesive papers.

C11- Printless multilayer white cardboard.

New multilayer white cardboard trimmings, without grey layer, without printing.

C12- White newsprint.

Unprinted, white newsprint trimmings and sheets, free from magazine paper.

C14- Coated white paper, with wood.

Coated white paper trimmings and sheets, with wood, unprinted.

C15- Coated white paper, wood-free.

Unprinted, wood-free, coated white paper trimmings and sheets.

C16- White trimmings with wood.

Unprinted, white paper trimmings and sheets, with wood, free from newsprint and magazine paper, containing not more than 20 % of coated papers.

C17- Mixed white trimmings.

Unprinted white paper trimmings and sheets free from newsprint and magazine paper, with a minimum of 60 % of wood-free paper, which may contain a maximum of 10 % of coated papers.

C18- Wood-free white trimmings.

Unprinted, wood-free white paper trimmings and sheets which may contain a maximum of 5 % of coated papers.

C19- Uncoated, wood-free white trimmings.

Unprinted, wood-free white paper trimmings and sheets, free from coated papers, or a mixture of two or more of the abovementioned waste papers.

On the condition that the whiteness of the cream ply remains high and is preferably higher than 60 (NF-Q 03-039), a colouring agent may be incorporated in it, in a small quantity, to give the paper a uniform shade enabling certain faults in the paper to be masked.

The layer(s) underlying the cream ply are, like the so-called grey paper, of a dark colour which may vary between a grey colour and a brown colour. They are obtained by starting from mechanical pulp and/or unbleached chemical pulp. In practice these pulps are frequently prepared from recovered raw materials such as, for example, kraft paper, kraft trimmings, waste corrugated cardboard and/or waste newspapers.

By way of example, the recycled papers referred to in the International Patent Application WO 88/0,371 are suited for the preparation of these dark-coloured underlying layers.

It is possible, furthermore, to have a second layer, also cream-coloured, between the cream ply and the dark-coloured underlying layer or layers; this "cream"-coloured layer may be of a composition similar to that of the cream ply described above. It may additionally comprise a proportion of bleached

mechanical pulp which is higher than that recommended in the case of the cream ply.

Advantageously, the paper to be coated is a paper treated to avoid a moisture uptake, such as a  
5 paper in which the "cream" ply is covered with a silicone-based film.

The coating slip is in the form of an aqueous suspension, more or less fluid, depending on its composition and its solids content.

10 The solids content of the slip is closely related to the coating system employed. Advantageously, in order to promote a surface deposition and hence to avoid its penetration into the paper, the solids content will be chosen higher than 40 % by weight.

15 The inorganic filler used for the preparation of the pigment slip may equally well be pulverulent or in suspension in water.

Calcium sulphate dihydrate and calcium carbonate are advantageously employed as an inorganic  
20 filler, being very advantageous in cost because of their commercial availability. Calcium sulphate dihydrate and calcium carbonate additionally yield particularly good results, both from an aesthetic viewpoint and that of protection, in particular in  
25 respect of light, by virtue, in particular, of their high opacifying power.

Calcium sulphate dihydrate has the additional advantage of bleaching when subjected to a heat treatment; this bleaching is advantageously obtained during  
30 the drying of the coated paper and in particular during the drying of the plasterboards clad with this coated paper. Calcium sulphate dihydrate whose particles are needle-shaped is preferably chosen, since these promote a uniform surface distribution making it possible to  
35 cover perfectly with a small weight of deposited layer. In addition, it has been observed that needle-shaped calcium sulphate dihydrate gives the pigment layer an open structure of low compactness, which promotes porosity.

Furthermore, it is preferably chosen in the form of needles with a length of between 3 and 5 microns.

Calcium sulphate, whose particles are spherical in shape, thus makes it possible to obtain a white covering exhibiting aesthetic qualities as well as the required mechanical properties.

Talc, kaolin, titanium dioxide and any pulverulent matter of mineral origin which is inert and white and which makes it possible to meet the abovementioned objectives as an inorganic filler, are also suitable for the invention. These materials may be employed by themselves or in combination. They are preferably employed in combination with calcium sulphate dihydrate and/or calcium carbonate. Because of the tendency which titanium dioxide-based pigment layers have, of being very easily marked by rubbing with certain metals, and of the prohibitive cost of this filler, it is recommended that it be employed in combination with inorganic matter to reduce these disadvantages.

The polymeric materials usually employed with the abovementioned fillers are suitable as a binder.

Because of their good property as a binder for the inorganic fillers employed in the pigment layer, preference is given very particularly to synthetic polymeric materials such as styrene-butadiene copolymers, polyvinyl acetates and polymers based on acrylic monomers, polymeric materials of natural origin such as starch-based polymers, modified or otherwise, and proteins such as casein, or a mixture of synthetic polymeric materials and/or of the abovementioned polymeric materials of natural origin. Starch has been found to be of particular interest because of the fact that its cost is advantageous. The coating slips containing it have a high hiding power and consequently the whiteness attained is higher, this being despite the lower solids contents of the starch-based coating slips when compared with the latex-based coating slips.

The coating slip employed to carry out the coating of the plasterboard paper preferably contains

from 6 to 25 % by weight of binder, calculated in relation to the total quantity of inorganic filler. Also preferably, when the binder is synthetic in origin, it is employed in a proportion of 8 to 15 % by weight in relation to the total quantity of inorganic filler and in a proportion of 10 to 20 % when it is starch-based.

To make the pigment slip easier to prepare and use, various adjuvants are incorporated therein.

To obtain a viscosity which is appropriate to the mechanical means employed for the application to the paper, at least one fluidifying agent is incorporated in the pigment slip, this being preferably a basic agent such as sodium hydroxide or aqueous ammonia, as well as at least one thickener known for its water-retention properties. The deposition of the pigment layer at the surface is, in fact, advantageously promoted by the use of at least one water-retaining agent.

The quantity of basic agents is preferably adjusted to obtain a pH of the order of 9.

The thickener suitable for the invention which is employed may be cellulose ethers such as hydroxyethyl cellulose, methyl hydroxypropyl cellulose, anionic cellulose ethers such as carboxymethylcellulose (CMC), polyvinyl alcohol, sodium alginates, galactomannans or a mixture of these compounds.

When the inorganic filler is a calcium sulphate it should be noted that anionic cellulose ethers may have a fluidifying effect under certain conditions (namely: small quantity of anionic cellulose ether and moderate content of other dispersing agents).

At least one dispersing agent is advantageously added to the coating slip, this being in order to complement the mechanical action during the dispersion of the inorganic fillers, that is to say the isolation of each particle in the coating slip, and to adjust the viscosity of the slip to a level which is compatible with the coating system. The addition of dispersing

agent becomes necessary in the case of coating slips with a high solids content. By way of example of dispersing agents, it is possible to use lignosulphonates, phosphated and/or sulphated and/or  
5 sulphonated and/or phosphonated linear or branched fatty alcohols, acrylic (co)polymers, in acidic or salt form, comprising a counteraction which may be an alkali or alkaline-earth metal and comprising functional groups such as phosphate and/or phosphonate groups; or  
10 a mixture of the abovementioned dispersing agents.

Stabilisers, optical bleaches and stearates may, in addition, be added to the coating slip. It is also possible to add coloured pigments in order to obtain a pigment layer whose shade is as close as  
15 possible to the shade of the joint and to avoid any contrast between them, since the shade of the joint can vary between white or cream shades with more or less pink and/or yellow shades.

In order to avoid the formation of bubbles and therefore to obtain a surface free from irregularities,  
20 an antifoam agent is preferably employed and those capable of forming an impervious film are avoided.

In order to eliminate the risks of degradation when the coated paper is wetted, for example when  
25 jointing coatings are installed between the plasterboards or when a wallpaper is stripped off, and to guarantee the maintenance of the mechanical characteristics of the pigment layer, at least one insolubilising agent which makes it possible to improve  
30 the water resistance is added, such as heat-curable resins based on a modified product of urea-formaldehyde condensation.

At least one agent capable of preventing the uptake of water in the pigment layer once it has been  
35 dried, such as silicone or microcrystalline waxes, is advantageously provided in the coating slip.

In this way, the water uptake kinetics of the coated papers according to the invention are greatly reduced. In addition, it has been noted that, when the



pigment layer contains a waterproofing agent, the moisture resistance of these coated papers, is markedly better and superior to that of a paper treated or otherwise with a waterproofing agent when it is covered  
5 with a pigment layer which is the same but free from waterproofing agent. It has been noted, in fact, that it is easier to obtain the required effects, with the required regularity, by adding the waterproofing agent to the coating slip rather than by performing a surface  
10 deposition of this agent. To avoid the problems of cohesion between the board-bound plasterboard and the jointing coating, it is recommended not to employ excessive waterproofing agents in the coating slip. The content of waterproofing agent preferably does not  
15 exceed 2 % by weight of the pigment slip, still more preferably it is between 0.5 % and 2 % by weight of the pigment slip.

According to a first, particularly advantageous embodiment of the invention, the pigment slip contains  
20 at least one flame-retardant agent which makes it possible to lower the ignition point of the paper. Sulphamates and antimony halides, such as antimony chloride and antimony bromide, may be mentioned as examples of a flame-retardant agent. The fire behaviour  
25 of the plasterboards lined with the coated paper according to the invention is thus improved.

When subjected to the so-called fire reaction chamber test (test detailed in the continuation of the description), the incorporation of a flame-retardant  
30 agent in the pigment layer makes it possible to increase the period preceding the ignition of the plasterboard. If the quantity of flame-retardant agent is sufficient, the ignition of the plasterboard thus treated can be successfully eliminated.

35 Thus, an appreciable lengthening in the ignition time of plasterboards clad with coated paper is noted as soon as the coating contains at least one gram of sulphamate per  $m^2$  of board. No ignition is produced in the majority of the plasterboards lined

with coated paper as long as the pigment layer contains at least 4 g of sulphamate per m<sup>2</sup> of board.

By virtue of the invention, in the case of a specified type of deposition, the abovementioned objectives are met with a pigment layer weight which is proportionately lower the higher the solids content of the pigment slip and the more opacifying the inorganic filler.

Various mechanical means can be employed for applying the coating slip onto the paper. As indicated above, the solids content is determined by the choice of the depositing technology. Those preferably chosen are the mechanical means capable of producing a deposit predominantly at the surface and employing coating slips of high solids content, generally higher than 60 % by weight, such as the systems using a scraping or smoothing blade or systems using equalising bars, in the case of which the excess coating slip is removed directly from the paper by a mechanical means. It is also possible to employ mechanical means which promote a deposition at the surface but which employ coating slips of lower solids content, of between 40 and 60 % by weight, such as air knife systems.

The mechanical systems which tend to promote the penetration of the coating slip but which are capable of depositing coating slips of solids contents higher than 40 % by weight are also suitable. In this latter category there may be mentioned coating systems of the roll type, in the case of which a slip film is formed on a roll before being transferred onto the paper (this transfer taking place in a nip and therefore under pressure); slips with a solids content of between 40 and 60 % by weight can be employed in this latter case. Provided that the weight of deposited layer can be at least 8 g/m<sup>2</sup> and that the inorganic filler included in the coating slip is highly opacifying, systems which promote the penetration of the slip and which employ coating slips of low solids content (20 to 30 % by weight) can also be employed;

systems with a rewetting calender may be mentioned among the latter.

However, the invention will be understood better from the detailed description of certain particular examples of embodiment, given by way of guidance and without restricting the invention.

The pigment slips, the paper sheets coated with these slips and the plasterboards exemplified are, unless stated otherwise, controlled using the following methods:

Characteristics of the coating slip

- Solids content (%) : ISO 787/2 (in the case of the slips containing  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , a temperature of  $55^\circ\text{C}$  is employed, in order not to degrade it into semihydrate and anhydrite)
- Brookfield viscosity (mPa.s) : measured with a Brookfield RVT apparatus, with RV spindles at  $23^\circ\text{C}$  and at 100 rev/min
- pH : measured at  $23^\circ\text{C}$  with the aid of a 12HA (high alkalinity) electrode standardised in the measurement range (pH 7 to 10) at the test temperature.

Characteristics of the uncoated paper sheet

- Weight per unit area ( $\text{g/m}^2$ ) : NF Q 03-019
- Thickness (mm) : NF Q 03-016
- Air porosity of the paper sheets (Gurley): ISO 5636/5
- Water absorption or Cobb 3 minutes ( $\text{g/m}^2$ ): NF Q03-014
- Whiteness obtained by the diffuse reflectance factor in the blue (wavelength of 457 nm) of the papers in order to evaluate one of the most important factors related to their whiteness : NF Q 03-039

- Degree of yellowing : obtained with the aid of the Elrepho Datacolor measuring apparatus
- Bendtsen roughness : NF Q 03-049

Characteristics of the coated paper sheet

- 10 - Weight of the pigment layer : according to the procedure indicated below
- Thickness (mm) : NF Q 03-016
- Air porosity of the coated paper sheets (Gurley) : ISO 5636/5
- 15 - Water absorption or Cobb 3 minutes ( $\text{g/m}^2$ ) : NF Q 03-014
- Whiteness obtained by the diffuse reflectance factor in the blue (wavelength of 457 nm) of the papers in order to assess one of the most important factors related to their whiteness : NF Q 03-039
- 20 - Degree of yellowing : given by the Elrepho Datacolor measuring apparatus
- 25 - Reaction to fire.

The fire reaction test was carried out under the conditions indicated in the decree of 30.6.83 which classifies materials according to their reaction to fire, and defines the test methods, as amended on 30 12.6.90 in accordance with the ISO Standard 834,1975 (F).

Determination of the weight of pigment layer deposited (dry weight of layer per unit area in grams per  $\text{m}^2$ )

35

- 1) Determination of the ash content at 800°C of the dry coating slip.

a) Drying of the coating slip

- the drying of the coating slip is carried out in a ventilated oven whose temperature is set at 55°C.

- the slip is spread on a watchglass and drying is continued until a constant weight is obtained.

5       - the drying time is set at 24 h in the case of a 10 g sample.

b) Calcination of the dry slip

A sample of dry slip (homogeneous sampling) is carefully weighed and then calcined to constant weight  
10 in a muffle furnace whose temperature is set at 800°C; the calcination period is generally 2 hours.

c) Ash content of the slip

- if  $m_0$  is the mass of the dry slip,

- if  $m_1$  is the mass of the ash after calcining,

15

the ash content of the slip is:  $t \% = (m_1/m_0) \times$   
100

2) Determination of the weight of layer deposited.

20       a) Ash at 800°C of the substrate paper and of the coated paper

Samples are cut from the substrate paper (before coating) and the coated paper with the aid of a 10 cm x 10 cm template.

25

The test pieces (10 cm x 10 cm) thus cut out are calcined in a muffle furnace until a constant weight is obtained, which is measured accurately (pressure balance).

30       if  $m_s$  is the mass of the ash of a substrate test piece (10 cm x 10 cm),

if  $m_c$  is the mass of the ash of a test piece of the coated paper (10 cm x 10 cm),  
the mass of the ash due to the pigment layer is:

$$m_{Cp} = m_c - m_s$$

35

since the samples all have an area of  $10^{-2} \text{ m}^2$ , the weight per unit area in grams per  $\text{m}^2$  of the ash of the pigment layer is:

$$C_p = m_{Cp} \times 100 \text{ in g/m}^2$$

b) Weight of layer deposited

Since the weight per m<sup>2</sup> of the ash due to the pigment layer, Cp, and the ash content of the coating slip are known, the dry weight of layer deposited is  
5 calculated as:

$$pdC = C_p \times (100/t \%) \text{ in g/m}^2$$

EXAMPLES 1 TO 13

For practical reasons the various papers and  
10 coating slips employed are denoted by a reference and are described in the following Tables I and II:

**TABLE I**

Paper Reference	Composition measured according to standard NF Q 03-001	Whiteness	Degree of yellowing	Gurley porosity (s)	Weight per unit area (g/m <sup>2</sup> )
P1	- 0 % of bleached chemical fibres - based on waste cardboard and paper of kraft grade	23.6	42.5	78.9	198.8
P2	- of the order of 10 % of bleached chemical cellulose fibres - of the order of 90 % of thermo-mechanical chemical pulp	27.6	25.7	47	260.9
P3	- not more than 29 % of bleached chemical cellulose fibres - of the order of 70 % of thermo-mechanical chemical pulp - the remainder consists of a filler	35.8	16.1	60	246.6
P4	- of the order of 60 to 65 % of bleached chemical cellulose fibres - of the order of 25 % of thermo-mechanical chemical pulp - of the order of 10 to 15 % of a filler	47.7	18.93	66	287.9
P5	Top ply obtained from 65 % of bleached and chemical cellulose fibres and 35 % of talc	64.9	4.08	44	225.8

5

The bleached chemical fibres forming part of the fibrous composition of P2, P3, P4 and P5 originate from coniferous bleached kraft and/or hardwood bleached kraft.

The coating slips are manufactured by means of a disperser and then filtered in order to separate off the undispersed agglomerates.

The compositions and the characteristics of  
5 the slips employed are given in the following Table II:



TABLE II

Slip reference	Slip Composition	Slip characteristics
S1	<p><u>Filler (% by weight of the dry formula)</u></p> <p>TiO<sub>2</sub> (100 % S.C.): 27.2  Kaolin (66.5 % S.C.): 36.87  Mica (100 % S.C.): 2.4  Aluminium silicate: 19.6</p> <p><u>Binder (% by weight of the dry formula)</u></p> <p>Polyvinyl acetate: 11.27  (50 % S.C.)</p> <p><u>Adjuvants (% by weight of the dry formula)</u></p> <p>HPMC (1): 0.3  Dispersant: 0.26  Antifoam (3): 0.4 % (6)  Ethylene glycol: 0.49  Hexylene glycol: 0.49</p>	<p>58 % solids content at 23°C</p> <p>- Viscosity:  5100 (n°6 spindle at 100 rev/min.)</p>
S2	<p><u>Filler (% by weight of the dry formula)</u></p> <p>CaSO<sub>4</sub>.2H<sub>2</sub>O as needles of length between 3 and 5 μm (100 % S.C.): 85</p> <p><u>Binder (% by weight of the dry formula)</u></p> <p>Styrene-butadiene copolymer (50 % S.C.): 10.3</p> <p><u>Adjuvants (% by weight of the dry formula)</u></p> <p>NaOH (100 % S.C.): 0.2  CMC (5) (17 % S.C.): 1.7  Dispersant (2) (40 % S.C.): 1.2  Antifoam (3): 0.1 % (6)  Insolubiliser (4) (40 % S.C.): 0.6  NH<sub>4</sub>Cl (40 % S.C.): 0.05</p>	<p>63.6 % solids content at 22°C</p> <p>- pH : 8.6  - viscosity : 1100 mPa.s</p>

- (1) HPMC denotes hydroxypropyl methyl cellulose
- (2) It is based on a sodium polyacrylate marketed under the name Coatex GX.
- (3) It is based on hydrocarbon and on a nonionic emulsifier.
- (4) It is based on a modified urea-formaldehyde condensation product.
- (5) CMC denotes carboxymethylcellulose.
- (6) % in relation to the wet formula.

After a suitable dilution allowing the required weight of layer to be deposited with the deposition system employed, the slips S1 and S2 are coated onto papers P1, P2, P3, P4 and P5. The coating operations are performed in the laboratory by means of an automatic bar application system, at controlled speed and pressure.

The characteristics of the coated papers obtained are given in Tables III, IV and V, which follow:

TABLE III

Exemple no	Paper and coating slip ref.	Weight per unit area (g/m <sup>2</sup> )	White-ness	Degre of yellowing	Cobb (50") (g/m <sup>2</sup> )	Weight of pigment layer (g/m <sup>2</sup> )	Gurley Permeability (1) (s)	Bendtsen Roughness (1) (ml/mm)
	P1	198.8 +/-0.6	23.6	42.5	23.3	0	78.9	857
1	P1-S1 (40 % solids content)	209.9	51.3	11.54		7	76.4	867
2	P1-S2 (45 % solids content)	205.8	45.3	15.92		6	91.9	667
3	P1-S2 (55 % solids content)	213.4	68.6	1.17		12	138	700
	P5	225.8 +/-2.38	64.9	4.08	52.4	0	44.5	902
4	P5-S1 (35 % solids content)	227	77.1	2.11		5	51.3	1 020
5	P5-S2 (55 % solids content)	236.3	72.6	3.17		13	107	750
6	P5-S2 (45 % solids content)	228.5	71.1	3.36		7	65.3	877
	P4	287.9 +/-12.6	47.7	18.93	67.2	0	66	1 100

7	P4-S1 (35 % solids content)	294.8	69.3	3.72		7	154	817
8	P4-S2 (55 % solids content)	281.4	65.4	7.1		14	269	1 133
9	P4-S2 (55 % solids content)	281.6	63.0	8.42		6	240	873
	P3	246.6 +/-1.2	35.8	16.1	53.7	0	60	1 677
10	P3-S1 (35 % solids content)	254.5	62.6	0.28		7	151	927
11	P3-S2 (55 % solids content)	264.4	54.4	5		8	312	893
	P2	260.9 +/-1.4	27.6	25.7	53.3	0	47	1 400
12	P2-S1 (35 % solids content)	270	64.5	-0.13		7	93.3	977
13	P2-S2 (55 % solids content)	269.8	51.8	6.19		8	244	1 167

- 5 (1) These measurements are carried out on coated (or uncoated) paper ready for use for forming plasterboards.

TABLE IV

5      Whiteness in relation to exposure to sunlight

ex. No	1	2	3	4	5	6	7	8	9	10	11	12	13
hrs of ex- pos- ure													
0	68.6	45.3	51.3	77.1	72.6	71.1	69.3	65.4	63	62.6	54.4	64.5	51.8
14	66.3	46	50.9	75.9	70.1	68.1	69.9	65.2	63.1	63.7	53.2	64.1	49.4
24	66.7	45.3	50.7	76.1	69.6	67.7	70.4	65.3	63.1	63.3	53.5	63.8	50.9
34	66.6	45.6	50.8	75.6	68.7	67	70.3	64.5	62.8	63.6	53.8	63.7	50.1
44	66.4	45.4	50.6	75.2	68	66.2	70.1	64.5	62.6	63.4	54	63.4	49.6
54	66.5	45.4	50.7	74.8	67.3	65.5	70.1	64	61.7	63.2	53.5	63.4	49.6
64	66.4	45	50.6	74.7	67.1	65.3	70.2	63.6	61.9	62.9	53.6	63.5	49.3
74	66.5	45.4	50.4	74.5	66.6	64.9	70.3	63.6	61.4	63	53.8	63.4	49.9

TABLE V

5      Degree of yellowing in relation to the exposure to  
sunlight

Hours of exposure								
ex. No	0	14	24	34	44	54	64	74
1	1.17	2.28	2.26	2.4	2.8	3.02	3.19	3.54
2	15.92	17	18.78	18.96	19.77	20.05	20.83	21.13
3	11.54	13.56	14.49	14.91	15.67	15.9	16.51	17.24
4	2.11	3.03	3.03	3.15	3.81	4.18	4.22	4.61
5	3.17	6.7	7.27	8.18	9.2	9.72	10.25	11.2
6	3.36	7.44	8.03	8.9	9.9	10.61	10.97	11.9
7	3.72	3.78	3.54	3.64	4.03	4.16	4.26	4.46
8	7.4	8.52	8.91	9.77	10.42	10.97	11.74	12.43
9	8.42	9.93	10.2	10.86	11.71	12.37	12.81	13.73
10	0.28	0.58	0.66	0.72	1.2	1.53	1.68	1.79
11	5	7.62	7.94	8.12	8.74	9.32	9.66	9.92
12	-0.13	0.43	0.59	0.72	1.24	1.39	1.61	1.89
13	6.19	9.72	9.56	10.37	11.42	11.82	12.21	12.25

10

On papers P1, P2, P3 and P4, whose surface quality is relatively rough, the coating quality is unsatisfactory, or even quite mediocre in the case of P1. The white shade sought after is, in fact, distributed very irregularly and emerges in the form of white spots which contrast greatly in relation to the remainder of the paper which is rather grey.

Only slip S1, which comprises a highly opacifying filler ( $\text{TiO}_2$ ) succeeds in masking these defects, on condition that the weights of pigment layers which are produced are higher than those shown in Examples 1, 7, 10 and 12; in this case an increase in the values corresponding to the Gurley porosity is then observed, reflecting a closing of a large part of the pores in the paper, which may be detrimental to the manufacture of plasterboards.

On the other hand, paper P5, whose surface quality is good (low roughness and homogeneity of distribution of the fibrous mass) reveals a surface of a uniformly distributed white shade after coating; these qualities result especially from the good distribution of the slip and from the fact that the colour of the slip is relatively close to that of the surface to be covered.

From the results obtained for Examples 1 to 13 it should be noted that, if the coated papers according to the invention are compared with the papers described in International Application WO 88/0,371, to which a slip based on  $\text{TiO}_2$  is applied by means of a system promoting the burial of the slip (rewetting calender), for an identical weight of pigment layer, the best initial whiteness is obtained with a paper comprising a white-coloured top ply and whose surface quality is homogeneous and even, such a paper being covered by means of a deposition system giving preference to the surface coating (roll system or air knife system) with a pigment layer based on calcium sulphate dihydrate, this being without considerable closing of the porosity of the coated paper.

When they are subjected to an identical exposure to sunlight, the coated papers covered with the aid of a  $\text{TiO}_2$  pigment slip remain stable, whereas those covered with a calcium sulphate dihydrate pigment slip age slowly (when compared with the aging of the same, uncoated papers). This result would have been quite different if the  $\text{TiO}_2$ -based pigment slip had been

applied with the aid of a system of the rewetting calender type as in the International Application WO 88/0,371. On penetrating the paper, the protective effect of the pigment layer decreases and the yellowing phenomenon would have been rapidly visible.

The coated papers including  $\text{TiO}_2$  are marked by the slightest rubbing with certain metal tools, whereas the coated papers containing  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  do not exhibit this defect.

#### EXAMPLE 14

A pigment layer is deposited industrially onto a paper of composition which is identical with that of the paper given reference P5 above, so as to produce a deposition of 14 to 20  $\text{g/m}^2$  with the aid of an air knife deposition system at a speed of 150 m/min.

The composition of the coating slip corresponds to slip S2 indicated in the preceding examples.

It will be noted that gypsum  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  has a considerable effect on the porosity of the coated paper. In fact, it minimises the closing of the paper in an appreciable manner when compared with the traditional fillers.

Reels of paper given references 1 to 3 were covered with the abovementioned coating slip; its characteristics are as follows:

- solids content: 47.2 % by weight
- Brookfield viscosity at 100 rev/min: 120 mPa.s  
(after 5 minutes' stirring at 1000 rev/min at 21°C
- RV spindle no. 2)

The reels of paper given references 4 to 6 were covered with the abovementioned coating slip; its characteristics are as follows:

- solids content: 43.4 %
- Brookfield viscosity at 100 rev/min: 84 mPa.s  
(after 5 minutes at 1000 rev/min, at 21°C
- spindle no. 2)

The characteristics of the coated papers obtained are listed in Table VI which follows:

TABLE VI

	Uncoated paper	Coated paper					
		reel 1	reel 2	reel 3	reel 4	reel 5	reel 6
Weight per unit area standard deviation (g/m <sup>2</sup> ) (NF Q 03-019)	227.3	236.7	244.2	246.3	243.0	241.5	242.3
thickness (mm) (NF Q 03-016)			0.360		0.356		
weight of layer (g/m <sup>2</sup> ) **	0	15.3	19.3	19.9	18.0	14.3	15.9
Gurley porosity (s) (NF ISO 5636/5)	39	102	121	133	102	89	76
whiteness	64.0	75.5	76.6	77.9	76.2	75.2	75.4
yellowing value *	4.27	2.70	2.37	2.24	2.67	2.37	2.49
Cobb (g) (NF Q 03-014)							
top side	52		63.2		66.2		
plaster side	56		76.3		83.5		
break (N)							
transverse direction	76		65		73		
machine direction (NF Q 03-004)	207		196		203		
I.B.T. (interply strength) (J/m <sup>2</sup> ) ***	85		90		86		
wet elongation (%) (NF Q 03-063)			2.32		2.21		

\* Elrepho Datacolor 2000-UV = 0 %-absolute DIN 5033 standard.

\*\* In muffle furnace at 800°C.

\*\*\* The interply strength is measured according to the TAPI-UM-403 procedure.



It is observed that the coated papers described in this example conform to the usual characteristics of papers for plasterboards.

Furthermore, the plasterboards covered with the  
5 coated papers described in this example do not present the user with differences in use, installation and utilisation, when compared with traditional plasterboards covered with uncoated paper.

However, during the use of the boards and more  
10 particularly during the installation of the plasterboard joints, beginnings of delamination can be observed in some cases. This results from the considerable rewetting, in certain uses, which is accompanied by the decrease in the cohesion of the  
15 plies due to decrease in the interply strength in a wet medium.

#### EXAMPLES 15 TO 16

A coating slip is deposited with the aid of a  
20 coating system of the roll type onto a paper with a Gurley porosity of 230 g/m<sup>2</sup> at 56 s, with a Bendtsen roughness equal to 1100, in which the whiteness of the top face is equal to 55 and in which the top ply is obtained from white-quality, group C waste paper in  
25 accordance with CEPAC standard 1990, and in particular of light periodical trimmings (class C1), of virgin white wood (class C11), of white newsprint broke (class C12) and of white trimmings (classes C14 to C17).

The coating slips employed are the following  
30 (the proportions are given in parts by weight of the formula on a dry basis):

#### Slip S3

##### Composition:

35	- NaOH	:	0.25
	- Carboxymethylcellulose	:	2
	- Dispersant	:	0.2
	- CaSO <sub>4</sub> · 2H <sub>2</sub> O, ground, made up of particles		

	smaller than 2 $\mu\text{m}$	: 100
	- Antifoam agent	: 0.1
	- Styrene-butadiene latex	: 12
	- Insolubilising agent based on a modified	
5	urea-formaldehyde condensation product	: 0.7
	- $\text{NH}_4\text{Cl}$	: 0.12

Brookfield viscosities at 100 rev/min, checked  
during industrial use : 450 mPa.s

10	Solids content (in % by weight)	: 63
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Slip S4

Composition:

15	- NaOH	: 0.1
	- Carboxymethylcellulose	: 1.0
	- Starch	: 16
	- Dispersant	: 0.2
	- $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , ground, made up of particles	
20	smaller than 2 $\mu\text{m}$	: 100
	- Antifoam agent	: 0.1
	- Insolubilising agent based on a modified	
	urea/formaldehyde condensation product	: 0.7
	- $\text{NH}_4\text{Cl}$	: 0.06
25	- Glyoxal	: 0.5

Brookfield viscosities at 100 rev/min, checked  
during industrial use : 490 mPa.s

30	Solids content (in % by weight)	: 53
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Table VII below shows the experimental results  
obtained by starting with the paper to which S3 is  
applied (Example 15) and paper to which S4 is applied  
35 (Example 16).

**TABLE VII**

References of example	Weight per unit area of coated paper (g/m <sup>2</sup> )	Weight of the pigment layer (g/m <sup>2</sup> )	Gurley porosity (s)	Initial whiteness	Initial yellowing value	Bendtsen roughness
Uncoated paper	228	0	70	55.4	5.6	1100
15 a	231	11.1	95	63.1	3.2	950
15 b	237	14.6	153	64.2	3.2	1000
15 c	241	17.1	210	65.6	2.9	1100
16 a	234	10.7	105	64.1	3.5	1250
16 b	238	16.7	170	68.3	2.7	1100

Wallpaper behaviour

13 mm. thick 30 cm x 30 cm plaster minibords were manufactured with the coated papers 16 b, 15 c, 15 b, 15 a and 16 a. The core of the minibords is based on plaster and various adjuvants used to facilitate their manufacture (setting accelerator and the like).

The plasterboards are not sized, but the paper is, with an adhesive based on methyl cellulose, marketed by Henkel under the name Metylan CL.

The wallpaper is applied without difficulty. The half-boards decorated with the paper are dried for 48 hours in a ventilated oven at 45°C. The removal (after the wallpaper has been wetted with water at 50°C and a wetting agent) takes place without tearing away the plasterboard paper or its pigment layer.

In addition, the results of the tests:

- of tearing away by pulling of studs adhesively bonded to these coated papers,
  - of tearing away jointing tapes,
  - of flexing of joints treated with overlay and made up by assembling two plasterboards,
- are equivalent to those obtained with the board-bound plasterboards.

### Reaction to fire

The classification of the material as a result of the radiation tests is based on the following measurements: time to ignition, sum of the maximum  
5 flame lengths, combustion period.

In the particular case of the plasterboard we have considered:

A- The time to ignition  $t_i$  in seconds, which is the period elapsed between the placing of the testpiece  
10 in the cabin and the moment of ignition.  
In the absence of ignition  $t_i$  is considered to be infinite.

B-  $h$  is the maximum length, expressed in cm, reached by the flames during each 30-second period,  
15 during each test.

$\sum h$  is the sum of the values of  $h$  for the duration of each test.

C- The total duration of hot combustion  $\Delta T$  in each test, expressed in seconds, is the total duration  
20 of presence of flame in one or more periods longer than 5 seconds.

$$\Delta T = e - t_i$$

$t_i$  = time to ignition

$e$  = extinction time

25 D- The classification value  $\sum$  is the arithmetic mean of the values  $q$  obtained at the end of each of the tests by the following formula:

$$30 \quad q = \frac{100 \sum h}{t_i \sqrt{\Delta T}} \quad \text{and} \quad \bar{q} = \frac{\sum q}{n}$$

$n$  being the number of tests.

A plasterboard is classified M1 when the classification value thus defined is lower than 2.5. It is classified M2 when this value is between 2.5 and 15.

35 On the basis of the measuring procedure of the decree of 30.6.83 as amended on 12.6.90 and of the ISO Standard 834-1975(F), the classification of the mini-boards incorporating a coated paper in accordance with the invention according to their reaction to fire is

given in Table VIII, which follows:

TABLE VIII

Test ref.	$\bar{a}$ and classification value $\xi$
15 a	2.35 - class M1
15 b	1.79 - class M1
15 c	2.08 - class M1
16 a	1.55 - class M1
16 b	2.89 - class M2

EXAMPLES 17 TO 20

EXAMPLE 17

A coating slip S5 similar to slip S3 is deposited onto a paper for plasterboard which is identical with that employed in tests 15 and 16, the only differences being the following:

- solids content (in % by weight) : 55 %
- deposition method of automatic : laboratory type  
bar application system
- weight of pigment layer deposited : 12 g/m<sup>2</sup>

EXAMPLE 18

This example differs from Example 17 only in the fact that a flame-retardant agent is added to the pigment slip S5, in this case an organic sulphamate marketed under the name Albaplas 695, so as to deposit 1 g of this agent per m<sup>2</sup> of paper.

EXAMPLE 19

This example differs from Example 17 only in the fact that a flame-retardant agent marketed under the name Albaplas 695 is added to the pigment slip S5, in a proportion of 2 g of this agent per m<sup>2</sup> of paper.

EXAMPLE 20

This example differs from Example 17 only in the fact that a flame-retardant agent marketed under the name Albaplas 695 is added to the pigment slip S5 in a proportion of 4 g per m<sup>2</sup> of paper.

The results of the fire reaction test on these minibboards produced with these papers coated with a slip containing a flame-retardant agent (Examples 17 to 20) and on the control (Example 17) are given in Table IX which follows:

TABLE IX

Test reference	$\bar{D}$ and classification value $\Sigma$
17	3.49 - class M2
18	0.98 - class M1
19	1.73 - class M1
20	0 (no ignition) class M1

EXAMPLES 21 AND 22

The papers employed have the same composition as the paper P5 described in Examples 1 to 13; the only difference between the two papers concerns the sizing medium which is:

- acidic in the case of the paper tested in Example 21 (an acidic sizing is also employed for preparing the papers tested in Examples 15 to 26);
- neutral in the case of the paper tested in Example 22.

A pigment layer with a solids content of 53.4 % is deposited industrially onto these papers in order to produce, with the aid of an air knife deposition system:

- Example 21: a deposition of 12 to 14 g/m<sup>2</sup>
- Example 22: a deposition of the order of 25 g/m<sup>2</sup>.

The weight of the pigment layer constitutes the only difference between Examples 21 and 22.

The composition of the coating slip employed is the following (unless stated otherwise, the proportions are given in percentage by weight on a dry basis per 100 % by weight on a dry basis of calcium carbonate):

5	- Calcium carbonate	: 100 % by weight on a dry basis of the dry formula
	- Styrene-butadiene copolymer	
10	with a solids content of 50 %	: 12 %
	- Sodium hydroxide	: 0.25 %
	- Carboxymethylcellulose	: 0.5 %
	- Dispersant based on a sodium polyacrylate marketed under	
15	the name COATEX GX	: 0.1 %
	- Antifoam based on hydrocarbon and on a nonionic emulsifier	: 0.1 % by weight relative to the wet formula
20	- Insolubiliser based on a modified urea-formaldehyde condensation product	: 0.7 %
	- $\text{NH}_4\text{Cl}$	: 0.06 %
	- Silicone as waterproofing agent	: 1 % by weight relative to the wet formula
25		

The characteristics of the coated papers obtained are reported in the following table:

	Example 21		Example 22	
	Uncoated paper	Coated paper	Uncoated paper	Coated paper
Weight per unit area standard deviation (g/m <sup>2</sup> ) (NF Q 03-019)	227 +/- 5	248 +/- 5	234 +/- 5	244 +/- 5
weight of layer (g/m <sup>2</sup> )	0	13.8	0	14.5
Gurley porosity (s) (NF ISO 5636/5)	60	103	25	101
whiteness (NF Q 03-039)	66.4	70.1	52.3	74.5
COBB (NF Q 03-014 TOP BOTTOM)	54 (1) 51 (1)	28 (2) 32 (2)	34 (1) 60 (1)	33 (2) 37 (2)
I.B.T. interply strength in J/m <sup>2</sup> in wet medium procedure TAPI-UM-403	63	95	122	176
Bendtsen roughness (NF Q 03-049)		1 391		1 008

(1) measurement performed at 3'50"

(2) measurement performed at 3'23"

5

#### EXAMPLE 23: Moisture behaviour test

Under the operating conditions of coating which are described in Example 14, the paper given reference P5 in Examples 1 to 13 is treated as follows:

10

a) paper P5 is covered with a pigment layer of slip S2: the layer weight is 16.0 g/m<sup>2</sup>; here the paper and the slip are not treated with a waterproofing agent;

15

b) paper P5 is pretreated against water uptake with the aid of a silicone film and is then covered



with a pigment layer of slip S2. The total layer weight is  $14.8 \text{ g/m}^2$  including the silicone in a proportion of approximately  $100 \text{ mg/m}^2$  of commercial product;

5 c) paper P5 is covered with a pigment layer of a slip which differs from S2 solely in that it contains silicone in a proportion of 1 % by weight relative to the wet formula. The total weight of the pigment layer is then  $15.1 \text{ g/m}^2$ ;

10 d) paper P5 is pretreated against water uptake with the aid of a silicone film and then covered with a pigment layer of the slip employed for carrying out the test 23(c) described above. The total weight of the pigment layer is then  $13.4 \text{ g/m}^2$ .

15 These four coated papers are employed for manufacturing board-bound plasterboards; it will be noted that the use of these four coated papers does not affect the plasterboard manufacturing process, which can consequently be conducted according to traditional operating conditions.

20 Good behaviour of these four coated papers was noted during the erection of a partition, in particular when the spatula was rubbing during the filling of the joints formed between the boards.

25 When a drop of water is deposited on these four coated papers a difficult penetration is noted in the case of the coated papers (c) and (d).

30 It was also noted that the resistance to rubbing with a moderate pressure, for example when in the case of the papers (c) and (d). The very clear improvement in the moisture behaviour of the papers coated with a slip containing a waterproofing agent was also noted by the Applicant Company in the course of a number of other tests.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

**CLAIMS**

1. Paper used as lining paper for plasterboards, characterised in that it consists of a sheet of lining paper for plasterboard, covered with a pigment layer, in that the top ply of the paper sheet, to which the said pigment layer is applied, is based on at least one light-coloured, and preferably white, inorganic filler and new or recovered, predominantly chemical, bleached cellulose fibres, in that the said pigment layer is based on at least one light-coloured, and preferably white, inorganic filler of a chemical nature which is identical with or different from that of the inorganic filler of which the said ply consists, of at least one binder and, if need be, of various adjuvants which make it possible to prepare a pigment slip of suitable rheology, and in that the weight of the deposited pigment layer is at least 6 g/m<sup>2</sup>.
2. Paper according to Claim 1, characterised in that the air permeability (Gurley porosity: NF Q 03-061) of the coated paper, before it undergoes a drying operation under temperature conditions similar to those employed during the drying of the plasterboard, is of the order of 100 s or higher, and may reach 150 s.
3. Paper according to either of Claims 1 and 2, characterised in that the pigment layer is situated predominantly on the surface of the ply of the paper sheet to be covered.
4. Paper according to one of the preceding claims, characterised in that the weight per unit area of the pigment layer is between 8 and 30 g/m<sup>2</sup> (NF Q 03-019).
5. Paper according to Claim 4, characterised in that the weight per unit area of the pigment layer is between 10 and 15 g/m<sup>2</sup> (NF Q 03-019).
6. Paper according to one of the preceding claims, characterised in that the whiteness of the surface of the cream ply, before coating, is higher than 50 (NF Q 03-039).

7. Paper according to Claim 6, characterised in that the whiteness of the surface of the cream ply, before coating, is higher than 60 (NF Q 03-039).

8. Paper according to one of the preceding claims, characterised in that the Bendtsen roughness of the surface of the cream ply, before coating, is lower than 1500 Bendtsen (NF Q 03-049).

9. Paper according to Claim 10, characterised in that the Bendtsen roughness of the surface of the "cream" ply, before coating, is lower than 1000 Bendtsen (NF Q 03-049).

10. Paper according to one of the preceding claims, characterised in that the cream ply is prepared by starting with at least 65 % by weight of bleached and chemical cellulose fibres.

11. Paper according to one of the preceding claims, characterised in that the content of mechanical pulp and/or of semichemical pulp and/or of unbleached chemical pulp and/or of thermomechanical pulp which is employed for preparing the cream ply does not exceed 30 % by weight.

12. Paper according to one of the preceding claims, characterised in that the incorporation of recycled, bleached cellulose fibres is carried out by adding, in the fibre preparation of the cream ply, unprinted waste paper of white grade, chosen from so-called top-quality group C waste paper, in accordance with the European waste-paper nomenclature (CEPAC-1990).

13. Pigment slip employed for preparing the lining paper for plasterboards as defined in one of the preceding claims, characterised in that the inorganic filler forming part of the composition of the pigment slip is calcium sulphate dihydrate or calcium carbonate.

14. Pigment slip according to Claim 13, characterised in that the calcium sulphate dihydrate particles are needle-shaped.

15. Pigment slip according to Claims 13 or 14, characterised in that the binder is chosen from

synthetic polymeric materials such as styrene-butadiene copolymers, polyvinyl acetates and polymers based on acrylic monomers.

16. Pigment slip according to Claims 13 or 14, characterised in that the binder is chosen from polymeric materials of natural origin and preferably starch.

17. Pigment slip according to Claims 13 or 14, characterised in that the binder consists of a mixture of synthetic polymeric materials and polymeric materials of natural origin.

18. Pigment slip according to one of Claims 13 to 17, characterised in that it comprises at least one fluidifying agent chosen from basic agents such as sodium hydroxide or aqueous ammonia.

19. Pigment slip according to Claim 18, characterised in that its pH is adjusted to a value of the order of 9.

20. Pigment slip according to one of Claims 13 to 19, characterised in that it comprises at least one thickener.

21. Pigment slip according to Claim 20, characterised in that the thickener chosen is an anionic cellulose ether and is also preferably carboxymethylcellulose.

22. Pigment slip according to one of Claims 13 to 21, characterised in that it comprises at least one dispersing agent.

23. Pigment slip according to one of Claims 13 to 22, characterised in that it comprises at least one flame-retardant agent.

24. Pigment slip according to one of Claims 13 to 23, characterised in that it comprises at least one insolubilising agent.

25. Pigment slip according to one of Claims 13 to 24, characterised in that it comprises at least one waterproofing agent for limiting the kinetics of water uptake of the papers in accordance with Claims 1 to 12.

26. Pigment slip according to Claim 25, characterised in that the waterproofing agent is a silicone.

27. Pigment slip according to one of Claims 13 to 26, characterised in that its solids content is higher than 40 % by weight.

28. Coating process characterised in that the application of the pigment slip defined in the preceding Claims 13 to 27 for preparing the lining paper for the plasterboards defined in the preceding Claims 1 to 12, is performed with the aid of mechanical deposition means chosen from those promoting a deposit of pigment layer predominantly on the surface of the cream ply, such as the systems using a scraping or smoothing blade or systems using equalising bars, when the slip has a high solids content, generally higher than 60 % by weight.

29. Coating process characterised in that the application of the pigment slip defined in the preceding Claims 13 to 27 for preparing the lining paper for plasterboards defined in the preceding Claims 1 to 12, is performed with the aid of mechanical deposition means chosen from those promoting a deposit on the surface of the cream ply, such as the coating systems of the roll type when the coating slip has a solids content varying between 40 % and 60 % by weight.

30. Coating process characterised in that the application of the pigment slip defined in the preceding Claims 13 to 27 for preparing the lining paper for plasterboards defined in the preceding Claims 1 to 12, is performed with the aid of mechanical deposition means chosen from those promoting a deposit on the surface of the cream ply, such as the air blade systems when the slip has a solids content varying between 40 % and 60 % by weight.

31. Coating process characterised in that the application of the pigment slip defined in the preceding Claims 13 to 27 for preparing the lining paper for plasterboards defined in the preceding Claims

1 to 12, is performed with the aid of mechanical deposition means chosen from those promoting the penetration of the coating slip, such as the rewetting calender systems for applying coating slips with a solids content higher than 40 % by weight, in that the inorganic filler prescribed in the coating slip is highly opacifying, such as titanium oxide or calcium sulphates with needle-shaped particles, and in that the weight of deposited pigment layer is higher than or equal to 8 g/m<sup>2</sup>.

32. Plasterboard lined with a paper in accordance with any one of Claims 1 to 12.

33. Plasterboard lined with a paper in accordance with any one of Claims 1 to 12 lined with a coating slip in accordance with any one of Claims 13 to 27.

DATED this 30th day of June 1992.

PLATRES LAFARGE

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